REMOVABLE/REUSABLE CLOSURE FOR CONTAINERS

Related Application

[0001] This application is related to and claims priority from co-pending, commonly-owned Provisional Application Serial No. 60/511,749 for an "LOCK TOP FOR A SOUP OR BEVERAGE CONTAINER" filed on October 16, 2003 and Provisional Application Serial No. 60/460,239 for "III FINGER LOCK TOP" filed on April 3, 2003.

Technical Field

[0002] The present invention relates to removable closures for containers, and more particularly, to a new and useful removable/reusable closure which locks to the container for positive retention during shipping, handling and use.

Background of the Invention

[0003] In today's fast pace work and home environments, the market for fast foods of the healthy variety, has grown steadily along with the trends in fitness, exercise and an overall desire to prolong youth. During the work week, time is at a premium and meals which can be prepared between meetings, conference calls or during the lunch work-out routine offer the best compromise between the consumption of snack foods or skipping a meal entirely. Energy bars, meal replacement beverages and condensed/powered mixtures (e.g., just add water) are more commonplace than ever. Corporate offices are sure to include a small kitchen including the many modern conveniences of home, i.e., refrigerator, stove, sink and microwave oven. The employee can, therefore, have his/her morning coffee, refrigerate lunch, and microwave dinner leftovers without ever leaving the comforts of the office.

[0004] Drinking beverages or eating meals while commuting to and from work offer yet other opportunities to save time which could otherwise be spent in the office. Most of us have experienced the frustration of a beverage container dropping, tipping and/or spilling as a consequence of an abrupt acceleration or deceleration of an automobile or other vehicle. As the container impacts the floor, console or table top, separation of the end closure can occur, resulting in spillage of the container contents. In addition to the mess produced by the spilled contents, the incident may be exacerbated by the temperature of the contents. With the ability of microwave ovens to quickly heat beverages and meals, high temperature liquids can be a source of burns.

[0005] End closures or caps commonly employed to close the open end of such containers typically include a U-shaped rim having a plurality of inwardly projecting extrusions to catch a raised lip of the container. The rim is generally flexible, allowing the rim to bow outwardly when the closure is pressed into engagement. *Crisi* U.S. Patent 4,209,107, *Yates, Jr.* U.S. Patent 4,387,828 and *Wong* U.S. Patent 6,460,716 are all exemplary of this type end closure. While some are more rigid than others, none of the foregoing provide a positive lock or securement for preventing detachment, especially when the container is mishandled, e.g., dropped. Furthermore, these end closures are prone to leaks and spillage due to the relatively poor integrity of the sealing surfaces therebetween. That is, the rim does not improve the efficacy of the seal.

[0006] Yet others provide a positive retention clip or hook to secure the end closure to the container. *Balint* U.S. patent 2,695,806 and *Poslinski* et al. U.S. patent 6,364,152 each disclose end closures having a locking structure which produces a positive engagement between the closure and container. While these devices provide a positive seal, the closure is difficult to detach without significant manipulation of the locking structures (i.e., requiring two hands to separate and, possibly a third to hold the container), at times requiring a separate tool e.g., a screwdriver, to effect disengagement thereof. Furthermore, these closure arrangements, provide marginal sealing integrity between the closure and container.

[0007] A need, therefore, exists for providing an end closure for a container which ameliorates the sealing integrity between the closure and container, provides positive

retention therebetween, and facilitates installation/removal with a single hand or a single motion.

Summary of the Invention

[0008] A closure is provided for a container having a raised lip proximal to an open end thereof, and includes: (i) a cap defining a cover, (ii) at least two locking levers including upper actuation and lower locking arms, and (iii) an elastically deformable hinge connecting the cap and each of the locking levers. Further, each of the lower locking arms define an inwardly projecting locking wedge. Each deformable hinge is located between the upper and lower arms of the locking lever thereby defining a point about which each locking lever may pivot. Radial displacement of the upper actuation arms results in radial displacement of each locking arm, thereby causing each locking wedge to releasably engage the container lip.

[0009] In one embodiment, each locking wedge has a guide and retention surface defining a lead and locking angle, respectively. The lead angle facilitates attachment of the closure by riding over the raised container lip while the locking angle effects positive retention and enhanced sealing by drawing the closure and container together, i.e., axially along the principle axis of the container.

Brief Description of the Drawings

[0010] For the purpose of illustrating the invention, there is shown in the drawings various forms that are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and constructions particularly shown.

[0011] Figure 1 is a perspective view of a container disposed in combination with an container closure according to one embodiment of the present invention.

[0012] Figure 2 is an isolated perspective view of one embodiment of the closure including a pair of locking levers disposed about the periphery of a central sealing cap.

[0013] Figure 3 is a top view of the closure shown in Fig. 2.

[0014] Figure 4 is a cross-sectional view of the closure taken substantially along line 4-4 of Fig. 3.

[0015] Figure 5 is an enlarged sectional view along an edge of the closure for illustrating one of the locking levers disposed in combination with a raised lip of the container.

[0016] Figure 6 is the same enlarged view of Fig. 5 illustrating the operation of the locking lever (i.e., the motion of the locking lever shown in dashed lines) and certain structural features including various angles for guiding and retaining the locking lever.

[0017] Figure 7 depicts a top view of an arcuate section of the closure.

[0018] Figure 8 is an isolated perspective view of another embodiment of the closure including three such locking levers disposed in equiangular increments about the sealing cap.

[0019] Figure 9 is an isolated perspective view of an alternate embodiment of the closure according to the present invention including an opening for dispensing the container contents and a hinged cover plate for closing and sealing the opening.

[0020] Figure 10 is an isolated perspective view of the closure of Fig. 9 with the hinged cover plate and vent tab shown in an open position.

[0021] Figure 11 is an isolated perspective view of yet another embodiment of the closure including a plurality of threads disposed internally of the cap and three locking levers disposed in equiangular increments about the cap.

[0022] Figure 11a is a top view of the closure shown in Fig. 11.

[0023] Figure 11b is a cross-sectional view taken substantially along line 11b-11b of Fig. 11a.

[0024] Figure 11c is an enlarged view of Fig. 13b illustrating a retention groove for accepting an O-Ring seal.

[0025] Figure 12 is an isolated perspective view of an alternate embodiment of the inventive threaded closure having elongate actuation arms to illustrate the locking wedges.

[0026] Figure 12a is a top view of the threaded closure of Fig. 12.

[0027] Figure 12b is a cross-sectional view taken substantially along line 12b-12b. of Figure 12a.

[0028] Figure 12c is the same cross-sectional view shown in Fig. 12b, illustrating the operation of the activation arms.

[0029] Figure 13 is an isolated perspective view of another alternate embodiment of a threaded closure according to the present invention.

[0030] Figure 13a is a top view of the invention threaded closure of Fig. 13.

[0031] Figure 13b is a cross-sectional view taken substantially along line 13b-13b of Fig. 13a.

Detailed Description of the Drawings

[0032] Referring now to the drawings wherein like reference numerals identify like elements, components, subassemblies etc. Fig. 1 depicts a container 4 in combination with an end closure 10 according to the present invention for closing an open end 6 of the container 4. The container 4 may be of any size or shape, may be used for holding any material, e.g., food or non-food product, and may be fabricated from any one of a variety of materials. The only specific requirement, however, is that the container 4 employ a raised lip 8, e.g., a rim, flange or other similar structure proximate to its open end 6. The raised lip 8 may be disposed directly adjacent the open end 6 of the container 4 or in close proximity thereto. For example, should the container 4 employ a threaded end, the raised lip 8 may be disposed above or below the threaded connection. An example of such a threaded connection will be illustrated later in the detailed description when discussing alternate embodiments. Furthermore, while the container 4 and closure 10 each have a substantially circular cross-section, it will be appreciated that the teachings of the invention are applicable to a variety of other cross-sectional shapes including, for example, elliptical, polygonal, etc. The following description and alternate embodiments of the invention are not intended to describe all

closure/container combinations, but merely illustrative of how the teachings of the present invention may be employed in the context of a variety of container configurations.

[0033] For the purposes of defining direction and/or angular orientation, it will be useful to define a cylindrical coordinate system Z-R wherein the Z-axis is coincident with the longitudinal axis 4_A of the container 4. Displacement in, or spatial orientation relative to, the Z-axis is referred to as "axial" displacement or position, while displacement or spatial orientation along radials R from the Z-axis will be referred to in terms of "radial" displacement or position. Furthermore, before discussing the functional characteristics of the various elements, it will be useful to provide a brief overview of the structural features, such as the geometry, spatial relationships and orientation, of the closure 10 according to the present invention.

[0034] In Figs. 2 - 4, the closure 10 includes a cap 12, at least two locking levers 14 disposed radially outboard of the cap 12, and an elastically deformable hinge 16 (best seen in Fig. 4) connecting the cap 12 and each of the locking levers 14. Generally, the cap 12 may be viewed as the portion of the closure 10 which preferably provides and air- or fluid-tight seal between the container 4 and the closure 10. In the described embodiment, the cap 12 comprises a cover 20 and an annular or ring member 22, which may provide a seal between the cap 12 and lip 8 of the container. Alternatively, sufficient sealing may be provided by the hinge 16 and the locking levers 14, i.e., to the extent that an edge of the cap 12 and lip 8 of the container 4 are closely aligned. As shown, the cover 20 is solid and impervious to air and/or liquid, however, as will be seen in alternate embodiments of the invention, the cover 20 may include one or more openings for dispensing or venting the material/product within the container 14. Finally, the cap 12 may include a segmented outer ring 23a, 23b for providing an aesthetically pleasing geometric appearance.

[0035] In Figs. 3 – 5, the sealing ring 22 projects axially downwardly, i.e., toward the opening 6 of the container 4, and preferably defines a sealing surface 24 (Fig. 5) adapted to detachably mate or contact with an interior surface 28 of the container lip 8. In one embodiment, the sealing surface 24 lies along a plane that is substantially the same as the interior surface 28. In another embodiment, the contact surfaces 24, 28 lie along planes that

are at an acute angle α with respect to one another so that upon placement of the cap on the container, the sealing surface 24 will come into contact with the inner surface 28 of the container 28.

[0036] In Fig. 5, each locking lever 14 includes actuation and lower locking arms, 30 and 32, respectively. The actuation arm 30 extends in one direction e.g., upwardly from the deformable hinge 16 in the figure, while the lower locking arm 32 generally extends in the opposing direction, e.g., downwardly from the hinge 16 in the figure. As such, the deformable hinge 16 lies vertically between or intermediate the actuation and lower locking arms 30, 32 and defines a fulcrum point 38 about which each locking lever 14 may pivot.

[0037] In Figs 5 and 6, the lower locking arm 32 includes a locking wedge 36 defining a lead angle β and a locking angle θ. The lead angle β is defined by the incline of a guide surface 36_G of the locking wedge 36 relative to the Z axis (or in the event that the guide surface is not linear, than the angle between the planes formed at the various points of contact on the guide surface and the Z axis. The locking angle θ is defined by the incline of a retention surface 36_R of the locking wedge 36 relative to the R axis. In one embodiment, the lead angle β is greater than about 8 degrees relative to the Z-axis and more preferably greater than 10 degrees. In one preferred embodiment, the lead angle lies within a range between about 11 degrees and 21 degrees. The locking angle θ is between 0 degrees to about 45 degrees relative to the radial R_V, although it is preferable that the angle line within a range that is greater than 0 degrees and less than 45 degrees. In one embodiment, the locking angle is between about 5 degrees to about 10 degrees.

[0038] Referring to Figs. 3, 6 and 7, in the illustrated embodiment, a pair of locking levers 14 are disposed about the periphery or circumference of the cap 12 (best seen in Fig. 3). Preferably, the levers 14 are spaced equiangularly about the circumference e.g., one-hundred and eighty degrees apart, however, the levers 14 may be spaced in unequal increments depending upon the particular application. As will be explained in subsequent paragraphs, more than two locking levers may be employed, however the number of locking levers 14 will, generally, not exceed a total of five.

[0039] The locking levers 14 may have any desired shape. For example the locking levers 14 may have a shape in the circumferential direction that is either linear or arcuate depending upon the desired cap configuration. In Figs 3 and 7, a top view of a locking lever 14 shows the curvature or arcuate shape of the lever 14 as it compliments or conforms to the periphery of the cover 20 in the circumferential direction. When employed about a circular cap 12, each locking lever 14 include locking tabs that may have an arc length corresponding to an angle φ. In one embodiment, the angle φ will be 45 degrees or less. In another embodiment, the range is between about 30 to 40 degrees. In one preferred embodiment, the angle is about 37 degrees.

[0040] The attachment and detachment of the closure 10 to the container 4 is now described with reference to Figs. 1-7. The description is applicable to the specific embodiment shown in the figures, however, the fundamentals generally apply to the alternate embodiments as well. Initially, the closure 10 of the present invention is aligned with the opening 6 of the container 4 such that the lower locking arms 32 and ring member 22 are adjacent the container lip 8. The closure 10 then is pressed axially downwardly against the container lip 8 such that the guide surfaces 36_G of the locking wedges 36 ride over an external surface of the lip 8. The deformable hinge 16 facilitates displacement of the lower locking arms 32 of the levers 14 as each locking wedge 36 passes the container lip 8. More specifically, the axial displacement of the closure 10 effects radial displacement of the lower locking arms 32 until the vertex V of the wedge 36 passes the lower edge 8_{LE} of the container lip 8. Once the vertex V of each wedge 36 passes the container lip 8, the deformable hinge 16 causes the locking wedges 36 to displace radially inwardly, i.e. toward the principle Z-axis of the container 4. More specifically, the elasticity of the deformable hinge 16 rotates the levers 14 to cause the locking wedges 36 to engage the container lip 8.

[0041] Disengagement of the closure 10 is effected by pressing the actuation arms 30 of the locking levers 14 radially inwardly (shown in dashed lines in Fig. 6) to pivot the lower locking arms 32 about the fulcrum 38, i.e., in the direction of arrow A. As such, the radially inward displacement of the actuation arms 30 causes the locking arms 32 to disengage from the container lip 8. Generally, this can be performed with the thumb and forefinger of the same hand, while the container 4 is held in the other hand. Finally, with the locking wedges

14 disengaged from the container lip 8, the closure 10 may be axially separated from the container 4.

[0042] The closure 10 of the present invention can be configured to provide an air- or fluid-tight seal while providing a positive lock for mitigating spillage, even when the container is inadvertently mishandled. The locking levers 14 operate to prevent axial separation and are preferably designed to produce an axial bias tending to more thoroughly and effectively seal the closure 10 to the container 4. That is, the locking wedges 36 each define a shallow locking angle θ (see Fig. 6) which, when combined with the elasticity of the deformable hinge, produce a compressive force on the sealing surfaces 24, 28. More specifically, the deformable hinge biases the locking wedge 36 into engagement with the container lip 8. The radial displacement of the locking wedge 36, i.e., towards the principle Z-axis, causes the retention surface 36_R to produce a small axial displacement. As such, the shallow locking angle θ provides a mechanical advantage to magnify the effectiveness of the deformable hinge 16. The axial displacement produced by the retention surface 36_R, in turn, increases the contact pressure on the mating surfaces 24, 28 and, consequently, the sealing effectiveness therebetween.

[0043] In addition to the retention surfaces 36_R, the guide surfaces 36_G also facilitate engagement of the closure 10 without the requirement to align the sealing surfaces 24, 28 or actuate the locking levers 14 . That is, the relatively steep lead angle β of the guide surfaces 36_G enables self-actuation of the locking lever 14. Thus, engagement of the closure 10 may be performed by one hand.

[0044] While the closure devices of the prior art are prone to disengage when a container is inadvertently mishandled, e.g., dropped or tightly grasped, the locking lever 14 of the inventive closure provides a positive lock to prevent detachment from the container 4. Additionally, it is preferable that the ring member 22 be configured to project or extend axially past the hinge 16 as shown in Figure 6 to form a sealing ring. As such, the ring member 22 functions to align the closure with the lip 8 during engagement and to structurally augment the lip 8 to inhibit deformation of the lip 8. As discussed above, such deformation can lead to separation of the closure from the container 10 and spillage of the contents.

[0045] One benefit of the closure 10 shown in the illustrated embodiment is that it can be installed and removed by one hand, while the other grasps the container 4. That is, the locking levers 14 are spatially positioned to be actuated by the fingers of one hand. Preferably the size of the closure 10 is consistent with that of an average individual, i.e., commensurate with a person's hand size and finger reach.

[0046] The closure 10 of the present invention may be manufactured by conventional low-cost fabrication techniques, such as injection molding, and in the described embodiment, is manufactured from injection-molded thermoplastic. The injection molding process, preferably, employs polypropylene plastic to produce an integral structure. That is, the cap 12, locking lever 14, and deformable hinges 16 are fabricated as a unit to form an uniform structure having substantially isotropic properties.

[0047] Various alternate embodiments of the invention are depicted in Figs 8 through 13b. In Fig. 8, three (3) locking levers 14 are spaced equiangularly about the periphery of the central cap 12. It will be appreciated that three fingers, working together, will be required to displace the upper actuation arms 30.

[0048] In Figs. 9 and 10, the closure 10 may include an opening 50 for dispensing the container contents. The opening 50 may be closed and sealed by a hinged cover plate 52 which may be integrally formed along the upper surface of the cap 12. While holding and dispensing a liquid, the closure 10 may include a vent 54 disposed through the cap 12 to facilitate fluid flow, i.e., to prevent a flow restricting vacuum within the container 4. Like the opening 50, a hinged vent plate 56 may be integrally formed to open and close the vent. Fig. 10 shows the hinged cover and vent plates 56. In this embodiment, the locking levers 14 are disposed on opposite sides of the hinged cover and vent plates 52, 56 so as not to interfere with cover opening 50 or vent 54. Further, to ensure that the locking levers 14 are not inadvertently actuated, a pair of locking levers 14a, 14b may be employed on each side of the opening 50.

[0049] In Figs. 11, 11a, and 11b another alternate embodiment is shown wherein the cap 12 of the closure 10 defines a cover 60 and a substantially cylindrical sidewall 62. Threads 64 are formed on the interior surface of the sidewall 62 for engaging threads 66 of the

container 4. A ring member 68, such as a sealing ring, is disposed between the cover 60 and a peripheral edge 70 of the container opening. Whereas in the prior embodiments, the sealing ring and locking wedges each engaged a portion of the container lip, i.e., radially inboard or outboard surfaces, the raised lip 8 of the container in Figure 11 is located below the threaded connection 74 and does not define a sealing surface. In Fig. 11c, a substantially circular groove 76 is formed internally of the cap and is preferably concentric with the cylindrical sidewall 62. The groove 76 accepts and retains a resilient O-ring seal 78 which aligns with and seals the container 4 when the threads are engaged.

[0050] The locking levers 14 are disposed about the cap 12, preferably one-hundred and twenty degrees apart from one another and, when the threads are engaged, the locking levers engage with the raised lip 8. That is, the closure must first be threaded before the locking wedges 36 of the levers 14 can ride up and over the raised lip 8, i.e., to effect engagement.

[0051] Figs. 12, 12a – 12c, depict yet another embodiment of the closure 10 wherein two closely-spaced locking levers 14 are disposed to one side of the cap 12 and the actuation arms 30 of the locking levers 14 are elongated to improve the mechanical advantage thereof about the fulcrum 38 of the hinge 16. Moreover, the closure 10 includes a cover portion 80 and an internal sidewall 82 which is spaced radially inward a sufficient distance from the actuation arm 30 to accommodate the additional motion produced by the longer actuation arm. Each locking lever 14 is disposed radially outboard of and integrally formed with its elastically deformable hinge 16. Furthermore, the actuation arm 30 is longer relative to the lower locking arm 32. Preferably the actuation arm 30 is approximately four times the length of the lower locking arm 32, thereby enabling a four-fold increase in the moment which may be applied to the deformable hinge 16. Accordingly, a thicker hinge 16 can be used which produces an increased locking bias, i.e., a higher radial load can be developed between the locking wedges 36 and the raised lip 8.

[0052] Inasmuch as the locking levers are paired on one side, the closure 10 may be coupled to the container 4 on the opposing side by any one of a variety of means. For example, the closure 10 may include a radially projecting heel or wedge (not shown) for engaging a recess or detent along an opposing wall structure of the container 4. The heel

would be inserted into the recess, and the closure 10 rotated about the heel, such that the locking wedges 36 may engage the container lip 8. Alternatively, the closure 10 may be pivotally coupled to the container 4 at one end with the locking wedges 36 latching the closure 10 at the other end.

[0053] In Figs. 13, 13a and 13b, another embodiment is shown wherein the closure 10 includes threads 90 located internally of the cap 12. This configuration is structurally similar to the embodiment described in Fig. 11, however, the sealing ring 92 is integrally formed with the cap 12 and projects axially downwardly toward the container opening 6.

[0054] Other embodiments of the inventive disclosure are depicted in Figs 13a and 13b which are generally applicable to all the configurations discussed above. For example, while the elastically deformable hinge 16 has been shown as a continuous structure, the hinge may be segmented to increase its flexibility and the ability of the locking levers 14 to pivot about the fulcrum 38. In Fig. 13a, the hinge 16 is segmented into three segments 16a, 16b and 16c. As shown in Fig. 13b, the cap 12 may include an abutment surface 94 disposed adjacent the inboard face 96 of the upper actuation arm 30. The abutment surface 94 functions to limit the pivot motion of the locking levers 14 and prevents over-extension of the deformable hinge 16. For example, a gap 98 is formed between the inboard face and the abutment surfaces 94, 96 and appropriated sized to prevent the strain levels in the hinge 16 from exceeding the yield stress, i.e., into the plastic deformation range, of the hinge material. Furthermore while the actuation and lower locking arms 30, 32 are shown as being vertically aligned in the figures, i.e., define a substantially straight angle, it will be appreciated that the arms 30, 32 may define an angle therebetween.

[0055] Referring to Figs. 2 and 11, the locking levers 14 preferably include a textured surface 11, such as a series of protrusions or dimples, that provide a gripping surface for the user's fingers. The textured surface assists in inhibiting the user's fingers from slipping off the levers as they actuate the levers.

[0056] Further, a variety of other modifications to the embodiments will be apparent to those skilled in the art from the disclosure provided herein. Thus, the present invention may be embodied in other specific forms without departing from the spirit or essential attributes

thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.